# APPARATUS AND METHOD FOR REPRODUCING INTERACTIVE CONTENTS BY CONTROLLING FONT ACCORDING TO ASPECT RATIO CONVERSION

## Technical Field

The present invention relates to a technique of reproducing an interactive content for interactive display from an information storage medium, and more particularly, to an apparatus and method for reproducing an interactive content by controlling a font according to an aspect ratio conversion, thereby minimizing display distortion.

## Background Art

Generally, audio and/or video (AV) content information and user definition information are recorded on an information storage medium. The AV content information is a content actually reproduced from the information storage medium, and the user definition information is unique information defined by a producer. When a general reproducing apparatus is used, only the AV content is reproduced from the information storage medium. When a device such as a computer is used, the user definition information can also be accessed and used.

Recently, interactive information storage media have been commercialized. The interactive information storage media can be used in a web-based environment using HyperText Markup Language (HTML) enabling a user interactive display. When information is reproduced from an interactive information storage medium, even when a general reproducing apparatus is used, a user can see an interactive image showing a tool, a text, or an image, which enables the user to access a network link and perform a search, together with an AV image showing an AV content.

FIGS. 1A and 1B show examples of a screen which can be

displayed in an interactive mode. FIG. 1A shows a screen having an aspect ratio of 4:3 (hereinafter, referred to as a 4:3 screen). FIG. 1B shows a wide screen having an aspect ratio of 16:9.

Conventional interactive information storage media are manufactured to have a markup document suitable only for a 4:3 screen having a pixel aspect ratio of 1:1, such as a screen of a personal computer's monitor. Accordingly, when an interactive image is displayed on a screen of a television (TV), the interactive image is displayed in an undesired format because the TV screen does not have a 1:1 pixel aspect ratio, and accordingly has a different screen aspect ratio. In other words, when an HTML file suitable for a screen having a particular pixel aspect ratio is reproduced from a conventional interactive information storage medium and displayed on a screen (e.g., a 4:3 TV screen) having a different pixel aspect ratio from the particular pixel aspect ratio, the HTML file is not displayed in a format desired by a content producer, as shown in FIG. 2.

When an interactive image is displayed on a display apparatus having a different pixel aspect ratio, image distortion occurs and the image has a different shape from that desired by a content producer. Therefore, there is a need for a method of displaying an interactive content in a format desired by a content producer without distortion on a screen having a pixel aspect ratio different from that of a produced markup document.

## Disclosure of the Invention

The present invention provides an apparatus and method for reproducing an interactive content by controlling a font according to an aspect ratio conversion, thereby minimizing display distortion.

The present invention also provides an apparatus and method for reproducing an interactive content by controlling a size of a font adapted to an aspect ratio conversion using aspect ratio information of a markup

document containing the aspect ratio information and resolution information which are optimally suitable for the markup document, thereby minimizing display distortion.

The present invention also provides an apparatus and method for reproducing an interactive content by enlarging or reducing a font having a predetermined pixel aspect ratio according to a resolution and an aspect ratio of a screen on which the font is to be displayed, thereby minimizing display distortion.

According to an aspect of the present invention, there is provided an apparatus for reproducing an interactive content from an information storage medium. The interactive content includes AV data including audio data and video data, a markup document, and/or a markup resource file. The apparatus includes a font control means, which determines a pixel aspect ratio of a font according to aspect ratio information and resolution information of an input markup document, performs a preprocess of enlarging or reducing a size of the font according to the determined pixel aspect ratio, and outputs the preprocessed font data adaptive to a change in the aspect ratio and resolution of the screen on which the interactive content is displayed.

According to an aspect of the present invention, there is provided a method of reproducing an interactive content from an information storage medium. The interactive content includes AV data including audio data and video data, a markup document, and/or a markup resource file. The method includes determining a pixel aspect ratio of a font according to aspect ratio information and resolution information of an input markup document, performing a preprocess of enlarging or reducing the font before displaying it, and outputting the preprocessed font data adapted to an aspect ratio and a resolution of a screen on which the interactive content is displayed.

Brief Description of the Drawings

The above and other features and advantages of the present invention will become more apparent by describing in detail preferred embodiments thereof with reference to the attached drawings in which:

FIGS. 1A and 1B show examples of a screen which can be displayed in an interactive mode;

FIG. 2 shows an example of distortion occurring when an image suitable for a screen having a 1:1 pixel aspect ratio is displayed on a screen having a 4:3 pixel aspect ratio without conversion;

FIG. 3 is a block diagram of a reproducing apparatus to which the present invention is applied;

FIG. 4 is a block diagram of an apparatus for reproducing an interactive content by controlling a font according to an aspect ratio conversion, according to an embodiment of the present invention;

FIG. 5 illustrates rotation of a font using control point data of font outline;

FIGS. 6A and 6B show examples of font outputs according to prior art and the present invention, respectively;

FIG. 7A and 7B show other examples of font outputs according to prior art and the present invention, respectively;

FIGS. 8A through 8C show other examples of font outputs according to the present invention and prior art; and

FIG. 9 is a flowchart of a method of reproducing an interactive content by controlling a font according to an aspect ratio conversion, according to an embodiment of the present invention.

Best mode for carrying out the Invention

Hereinafter, preferred embodiments of the present invention will be described in detail with reference to the attached drawings.

FIG. 3 is a block diagram of a reproducing apparatus to which the present invention is applied. The reproducing apparatus includes a reader 1, a buffer memory 2, a cache memory 3, a decoder 4, a control

unit 5, and a blender 7. The control unit 5 is provided with a presentation engine 6. The reader 1 includes an optical pickup unit (not shown), which reads data by radiating a laser beam onto an interactive information storage medium 100.

The interactive information storage medium 100 provides various types of information and AV convents, which can be displayed in a user interactive environment. The interactive information storage medium 100 has a markup document containing indication information on a resolution and an aspect ratio of the markup document so that an interactive image can be appropriately displayed at a particular screen aspect ratio. Generally, a font having a square pixel aspect ratio is used in a markup document, but a format of the font may vary with content producers.

The reader 1 controls the optical pickup unit to read AV data and a markup document from the interactive information storage medium 100 according to a control signal from the control unit 5. The buffer memory 2 buffers the AV data, and the cache memory 3 caches a playback control information file for controlling the playback of the AV data and/or the markup document or caches other necessary information. The control unit 5 controls the reader 1, the decoder 4, the presentation engine 6, and the blender 7 so that the AV data is reproduced from the interactive information storage medium 100 in a video mode or an interactive mode according to a user's selection.

The presentation engine 6 is an analytical engine analyzing markup languages and program languages such as JavaScript and Java. The presentation engine 6 may include various plugins. The plugins enable users to open markup resource files of various formats, which are included in or linked to markup documents. In other words, the presentation engines 6 serves as a markup document viewer. In an embodiment of the present invention, the presentation engines 6 can access the Internet and read predetermined data.

The presentation engines 6 fetches a markup document from the cache memory 3 and then analyzes and renders it in the interactive mode. The blender 7 blends an AV data stream and the rendered markup document so that the AV data stream is displayed on a display window defined by the markup document, that is, an AV image is embedded in a markup document image, and outputs the result of blending to a display apparatus 200.

In particular, the presentation engine 6 enlarges or reduces a font made at a square pixel aspect ratio using aspect ratio information of a markup document containing resolution information and the aspect ratio information which are suitable for the markup document in order to minimize distortion of interactive data. As a result, the interactive data can be displayed in the original font on a screen having a different resolution and aspect ratio from the original resolution and aspect ratio of the markup document with distortion.

FIG. 4 is a block diagram of an apparatus for reproducing an interactive content with control of a font according to an aspect ratio conversion, according to an embodiment of the present invention. In FIG. 4, a sub-image is sub picture data overlapping a video image. The sub-image and the video image are provided from the decoder 4 shown in FIG. 3.

A video converter 71 is controlled by a controller 72 to convert a format of the video image into a pan & scan format or a letterbox format according to a screen aspect ratio and a resolution of the display apparatus 200 or to output the video image from the decoder 4 as it is without converting it. A first mixer 73 mixes the video image from the video converter 71 and the sub-image. A video position/image size controller 74 controls a position of the mixed image from the first mixer 73 and a size of an AV image displayed on a screen of the display apparatus 200 according to input video layout information.

A graphic image converter 75 is controlled by the controller 72 to

convert a size (a length or a width) of a graphic image of a markup image source provided from the presentation engine 6 according to aspect ratio information of a document. A second mixer 76 mixes an output of the video position/image size controller 74 and an output of the graphic image converter 76 and outputs the result of mixing to the display apparatus 200 so that the result of mixing can be displayed on the screen of the display apparatus 200. The controller 72 controls the video converter 71 and the graphic image converter 75 according to the screen aspect ratio and the resolution of the display apparatus 200. The video converter 71, the controller 72, the first mixer 73, the video position/image size controller 74, the graphic image converter 75, and the second mixer 76 constitute the blender 7.

Meanwhile, it is preferable that an interactive image display file is a markup document, such as a web-based document file, made using a markup language or a markup resource file, such as an image, an animation, or a font.

Although not shown, the presentation engine 6 includes a markup document parser and a style sheet parser. A markup document is parsed by the markup document parser to generate a document tree, which conforms the following rules. Firstly, a root node of all nodes is set as a document node. Secondarily, all of texts and elements generate a node. Thirdly, a processing instruction, a comment, and a document type generate a node. The style sheet parser parses a style sheet, which allows a format of the markup document to be freely set, to generate a style rule and a selector list. The style sheet parser provides the video layout information input to the video position/image size controller 74 and layout information of markup resources linked to the markup document (referred to as markup resource layout information). The markup resource layout information is input to a markup image mixer 64.

Based on the document tree, an image decoder 61 decodes

image data, an animation decoder 62 decodes animation data, and a font decoder 63 decodes text data according to font-related information to provide text data having an appropriate font. The font-related information may include unicode information (font information for international standardization) and font family information or may be font information stored in a reproducing apparatus as default.

Particularly, in the present invention, the font decoder 63 enlarges or reduces a font using a matrix value previously set for the screen aspect ratio of the display apparatus 200 based on aspect ratio information of the markup document output from the markup document parser, and outputs font data. The operation of the font decoder 63 will be described in detail later with reference to FIGS. 5 through 9.

The markup image mixer 64 mixes outputs of the image decoder 61, the animation decoder 62, and the font decoder 63 according to the markup resource layout information to generate a markup image source and provides the markup image source to the graphic image converter 75 of the blender 7.

The image decoder 61, the animation decoder 62, the font decoder 63, the markup image mixer 64, and other units (not shown) constitute the presentation engine 6.

Preferably, a markup document displayed in an interactive image contains resolution information and aspect ratio information indicating a 16:9 screen, a 4:3 screen, a 1:1 screen, or no-relation to the screen aspect ratio which includes a case where no aspect ratio is set for the markup document. Table 1 shows examples of the resolution information and the aspect ratio information. When the markup document contains neither the resolution information nor the aspect ratio information, basic screen information set in a reproducing apparatus can be utilized. For example, the basic screen information may include a horizontal resolution of 720 pixels, a vertical resolution of 480 pixels, and an aspect ratio of 14:9.

Table 1

| Pixel aspect ratio | 1:1 | 0.888:1 | 1.186:1 | Only resolution without pixel aspect ratio is set |
|---|---|---|---|---|
| Examples of use | R720×405, A1×1<br>R720×540, A1×1<br>R1920×1080, A1×1 | R720×480, A4×3<br>R720×576, A4×3 | R720×480, A16×9<br>R720×576, A16×9 | R720×480<br>R720×576<br>R1920×1080<br>R960×540 |

The resolution information and the aspect ratio information of the markup document can be embedded into the markup document using a tag, for example, <meta name="bestlook" content="Rresolution value,Aaspect ratio value">. In an example of modification, <link href="foo.css" type="text/css" device-aspect-ratio="aspect ratio value"/> may be used. The resolution information and the aspect ratio information indicate a resolution and an aspect ratio at which the markup document is displayed most optimally. The following is an example of a markup document in which an aspect ratio and a resolution are combined.

```
<?xml version="1.0" encoding ="UTF-8"?>
<!DOCTYPE html PUBLIC-//DVD/DTD XHTML DVD-HTML1.0//EN"
"http://www.dvdforum.org/enav/dvdhtml-1.0.dtd">
<html>
<head>
<title>720x480, 4x3 PAGE</title>
<meta name="bestlook" content="R720x480,A4x3"/>
<link href="foo.css" type="text/css" device-aspect-ratio="4:3"/>
<script language="ecmascipt">
<![CDATA[
function onload_handler()
{
  idplayer.play();
  idplayer.enable VideoTransform(0);
  //Disable first video transform when a value is 0 and enable first video transform when
a value is 1.
  }

]]>
</script>
</head>
</body id=" docbody" onload="onload_handler()">
<objet style=" position: absolute; left: 150px; top: 100px; width: 370px; height:250px"
```

```
data="dvd:video_ts" id="idplayer"/>
Interactive Data
</body>
</html>
```

Generally, fonts are produced on a screen having a 1:1 (square) pixel aspect ratio. Information on a font is composed of a coordinate point, and thus a two-dimensional transformation such as enlargement, reduction, or rotation can be easily performed using control point data of a font outline, as shown in FIG. 5.

However, a TV screen does not have the square pixel aspect ratio. As shown in Table 2, when a screen aspect ratio is 4:3, a pixel aspect ratio is 0.888:1. When a screen aspect ratio is 16:9, a pixel aspect ratio is 1.186:1.

Table 2

| Screen aspect ratio at 720×480 (NTSC) | 4:3 | 16:9 |
|---|---|---|
| Pixel aspect ratio | 0.888:1 | 1.186:1 |

Accordingly, when a font having the square pixel aspect ratio (hereinafter, referred to as a 1:1 font) is output to the TV screen without being changed, phenomena described below occur.

As shown in FIG. 6A, when a 1:1 font is output to a screen having a pixel aspect ratio of 0.888:1 (i.e., a screen having a resolution of 720×480 and a screen aspect ratio of 4:3) without being converted, the 1:1 font becomes narrow. When an interactive content is displayed, if the 1:1 font is enlarged at a ratio of 1.125:1 and then output to the screen having a pixel aspect ratio of 0.888:1, the 1:1 font can be displayed normally. Accordingly, the font decoder 63 enlarges the 1:1 font at the ratio of 1.125:1 using matrix information and then outputs the enlarged font to the 4:3 screen so that the font can be displayed normally. In other words, the enlarged font is reduced at a ratio of 0.999:1 on the screen having a pixel aspect ratio of 0.888:1 (i.e., the screen having a resolution of 720×480 and a screen aspect ratio of 4:3) and thus looks like the 1:1 font, as shown in FIG. 6B.

As shown in FIG. 7A, when a 1:1 font is output to a screen having a pixel aspect ratio of 1.186:1 (i.e., a screen having a resolution of 720×480 and a screen aspect ratio of 16:9) without being converted, the 1:1 font becomes wide. When an interactive content is displayed, if the 1:1 font is reduced at a ratio of 0.843:1 and then output to the screen having a pixel aspect ratio of 1.186:1, the 1:1 font can be displayed normally. Accordingly, the font decoder 63 reduces the 1:1 font at the ratio of 0.843:1 using matrix information and then outputs the reduced font to the 16:9 screen so that the font can be displayed normally. In other words, the reduced font is enlarged at a ratio of 0.999:1 on the screen having a pixel aspect ratio of 1.186:1 (i.e., the screen having a resolution of 720×480 and a screen aspect ratio of 16:9) and thus looks like the 1:1 font, as shown in FIG. 7B.

FIG. 8A shows an example of text data normally displayed when the font decoder 63 enlarges or reduces a 1:1 font according to a screen aspect ratio. FIG. 8B shows an example of the text data narrowly displayed when the 1:1 font is output to a screen having a pixel aspect ratio of 0.888:1 (i.e., a screen having a resolution of 720×480 and a screen aspect ratio of 4:3) without being converted. FIG. 8C shows an example of the text data widely displayed when the 1:1 font is output to a screen having a pixel aspect ratio of 1.186:1 (i.e., a screen having a resolution of 720×480 and a screen aspect ratio of 16:9) without being converted.

The font decoder 63 stores values for enlarging or reducing a font according to aspect ratio information contained in a markup document as matrix information, as shown in Table 3. Table 3 shows a matrix used for a 4:3 screen (having a pixel aspect ratio of 0.888:1 and a resolution of 720×480), a matrix used for a 16:9 screen (having a pixel aspect ratio of 1.186:1 and a resolution of 720×480), a matrix used for a basic 14:9 screen (having a pixel aspect ratio of 1.031:1 and a resolution of 720×480), and a matrix used for a screen having a pixel aspect ratio of

1:1 (wherein a resolution is 960×540 or 1920×1080).

Table 3

| Pixel aspect ratio | 0.888:1 | 1.186:1 | 1.031:1 | 1:1 |
|---|---|---|---|---|
| Matrix information | $\begin{bmatrix} 1.125 & 0 \\ 0 & 1 \end{bmatrix}$ | $\begin{bmatrix} 0.843 & 0 \\ 0 & 1 \end{bmatrix}$ | $\begin{bmatrix} 0.3 & 0 \\ 0 & 1.0 \end{bmatrix}$ | $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ |

FIG. 9 is a flowchart of a method of reproducing an interactive content by controlling a font according to an aspect ratio conversion, according to an embodiment of the present invention. FIG. 9 shows an example of the operation of the font decoder 63 implemented in software.

It is determined whether a markup document contains aspect ratio information, for example, whether a markup document contains a tag <meta name="bestlook" content="Rresolution value,Aaspect ratio value"> or a modified tag <link href="foo.css" type="text/css" device-aspect-ratio="aspect ratio value"/> (901). When it is determined that the markup document contains the aspect ratio information, the aspect ratio information is input as screen aspect ratio information (902). When it is determined that the markup document does not contain the aspect ratio information, basic screen aspect ratio information set in a reproducing apparatus is input as the screen aspect ratio information (903). A font is enlarged or reduced using matrix information (as shown in FIG. 3) corresponding to the screen aspect ratio information (904). Then, font data composed of control points resulting from the enlargement or reduction of the font is rasterized for display (905). Thereafter, the rasterized font data is mixed with other elements (an image, animation, etc.), and the result of mixing is displayed on a screen (906).

## Industrial Applicability

As described above, according to the present invention, when interactive image information optimally displayed at a particular aspect

ratio is reproduced from an information storage medium and displayed on a screen having a different screen aspect ratio from the particular aspect ratio, a font is enlarged or reduced using matrix information corresponding to the particular aspect ratio, so that the original font desired by a content producer can be normally displayed on the screen, and an interactive image can be displayed on the screen with a minimum distortion.